A Coupled Analytical Model For Salt Intrusion and Tides In Convergent Estuaries

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ABSTRACT
In this paper we develop a coupled analytical model for salinity and tidal propagation in estuaries where the cross-sectional area varies exponentially. A simple analytical model for tidal dynamics has been used to estimate the tidal excursion, which has an important influence on the salt intrusion process since it determines the extreme salinities (i.e. salinity distribution for high water slack and low water slack). The objective of the coupling is to reduce the number of calibration parameters, which subsequently strengthens the reliability of the salt intrusion model. Moreover, the coupling enables us to assess the potential impacts of external changes, both human-induced interventions (e.g. dredging) and natural changes (e.g. global sea level rise), on the salt intrusion process. In addition, the fully analytical solution for hydrodynamics allows immediate estimation of the tidally averaged depth and friction coefficient for given water level recordings and salinity measurements. This is particularly useful when a geometric survey is not available. The coupled model has been applied to six previously unsurveyed estuaries in Malaysia and the results show that the correspondence between analytical estimations and observations is very good. Thus, the coupled model proves to be a useful tool to obtain estimates of salt intrusion in estuaries based on a minimum amount of information required and for assessing the effect of human-induced or natural changes.

KEYWORDS: Analytical solution; tidal dynamics; convergent estuaries; tidal excursion; coupling

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